For interference sensing through pilot channels to give adequate protection to microwave users, pilot channels must become unusable (upon power on scanning or upon movement of subscriber terminal into interfering zone) at a threshold where the fixed microwave user is assured no detectable interference will occur to the fixed microwave transmission. This will have to be tested. It was, however, QUALCOMM's initial opinion that the power level on the pilot channel and the receiver sensitivity of the subscriber terminal regarding the pilot channel are already together set at a threshold such that pilot channels would become unusable before associated traffic channels become potential interferers to fixed microwave transmission.[13] The threshold with regard to pilot channel access must, of course, be set rigorously enough that absolute protection is given to the microwave user.[14]

B. Effect of Summed Power.

As noted above, the approach outlined in CTP's pioneer's preference request involves initial exclusion of interfering channels and regular base station scanning of remaining useable channels. In a CDMA system this approach must deal with the increase in power in a cell (and the increased summed power of all transmissions on a certain potentially interfering frequency in a cell) which occurs when demand in a CDMA cell increases relative to neighboring cells. Possible solutions are:

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user as a pilot channel only slightly degraded by fixed microwave interference would be rejected for a pilot channel not so degraded (i.e., a stronger pilot channel).

[13]Note that in cases where the subscriber terminal is very near the base station a pilot channel might be adequately received by the subscriber terminal despite microwave interference. However, the accompanying transmission channel would already have been blocked out by the base station which would have identified the same microwave interference from the base station site.

[14]Obviously the question is not whether fixed microwave interferes with the CDMA channel but whether the thresholds are set rigorously enough to protect fixed microwave users from the CDMA channel. This must be at a level where the summed power of all transmissions on a channel do not interfere with the fixed microwave transmission.

It should also be noted that use of pilot channels for interference sensing accomplishes frequency agility and the ability to move handsets throughout the U.S. (on ISCDMA systems) as outlined in the CTP/BNR patent application and other papers filed with the FCC in 1990.

- Do the initial channel exclusion at base station site based on "normal" operation, and then incorporate an algorithm which removes additional channel(s) from use as summed power on the channel(s) increases. These would be channels which were "near interferers" in that while acceptable to the fixed microwave user at normal base station power, might cause interference at higher summed power. Of course, the effect of this solution would be to remove channel capacity just as it is needed - in a high demand situation.

- Exclude initially all channels which at highest summed power might interfere at base station site with fixed microwave. This means lost capacity in normal operation, but in normal use the capacity might not be needed in any case.

- Use pilot channel interference sensing. When demand increases in a CDMA cell relative to neighboring cells, the high demand cell expands in power to serve the demand, and "borrows" capacity from neighboring, lower demand cells. Subscriber terminals near the edge of the high demand cell will find pilot channel signals degraded by distance and interference caused by the high number of users already on the particular transmission channel. If the transmission channel is additionally a "near interferer" to a fixed microwave transmission, this interference will be added to the signal degradation caused by distance and high demand user interference. The result will be that as demand increases, and summed power on a given transmission channel starts to increase, pilot channel degradation should prevent addition of subscriber terminals which will turn near interference into actual interference to the fixed microwave user. Again, this will have to be tested.

C. Use of FDD Rather than TDD.

QUALCOMM has already suggested an answer to the problem of having to coordinate paired channels (FDD) in a fixed microwave environment. The answer is to use the same channel offset as used by the fixed microwave transmission, normally 80 MHz.[15] Thus proper non-interfering coordination of the forward or reverse channels would correspondingly result in coordination of the reverse or forward channels.[16]

ISCDMA in Practice. CDMA has demonstrated capacity advantages over TDMA. These advantages grow in operation in a fixed microwave environment. A CDMA channel can operate closer in geography and frequency to a fixed microwave transmission without interfering with the transmission because of CDMA spectrum spreading and low power. This translates to additional capacity.[17] The capacity of ISCDMA depends upon both fixed microwave interference and cell size in a geography.

A. Low Interference Geographies.

Clearly the capacity of narrow channel CDMA is such in many parts of the country that the equivalent of 120 MHz that may be eventually needed for PCS can be found by simple frequency coordination approaches.[18] All potentially interfering channels in a given cell in many parts of the country

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[15]It is to be noted that an FDD system has one advantage over a TDD system in application of the CTP interference sensing approach. Assume a quite distant microwave transmitter (30 miles or more) and a nearby microwave receiver. In a TDD system the subscriber terminal threshold of interference sensing would have to be very carefully set to ensure that the distant microwave interferer was in fact heard and subscriber transmission not commenced on the same TDD channel, causing interference to the nearby microwave receiver. On the other hand, with both microwave transmissions and CDMA FDD transmissions offset at 80 MHz, the microwave receiver that would be affected by the subscriber terminal transmission would be the 30 mile plus distant microwave receiver in the example given, resulting in perceived interference to subscriber terminal equating to far less than actual interference to microwave receiver.

[16]Another possible problem for the QUALCOMM system in a fixed microwave environment is soft handoff. It appears, however, that even though different pilot channels (and transmission channels) will be unavailable in different cells because of fixed microwave interference, the QUALCOMM system would easily adjust to this, using hard handoff where soft handoff is unavailable.

[17]It should be noted that the capacity increase of CDMA over TDMA is greater in a fixed microwave frequency sharing environment than, for example, in cellular radio use in the absence of direct interference.

[18]See CTP's and Northern Telecom's filings with the FCC regarding PCS NOI (Gen. Docket No. 90-314) in October 1990 which detail frequency need.

could be blocked out and there would still be enough free frequency in the 1850 - 1990 MHz band to provide adequate PCS capacity using CDMA. This is particularly true where areas of low microwave interference correspond to areas of low PCS demand (more rural or suburban areas).

In such geographies, the advantages of ISCDMA lie not in capacity gain but in certainty gain.

- Regulatory certainty. Under ISCDMA whether scanning is done using pilot channels, or using a separate control channel, channel rejection depends upon sensed thresholds of interference. These thresholds can be set so that no detectable interference can occur to the fixed microwave user. ISCDMA subscriber terminals can then be moved throughout the country, into a variety of fixed microwave transmission conditions, and wherever they are, the subscriber terminals will not interfere. Similarly, if interference sensing is incorporated in base stations as described in CTP's pioneer's preference request, no base station could operate on a channel which interferes with fixed microwave transmission at the base station site. This means that if channel exclusions are improperly computed when the base station is sited (certain interfering channels not removed from the list of useable channels), or if the base station is moved to a new area (moved wireless PBX, residential cordless phone or perhaps Telepoint base station) the base station would automatically adjust to exclude interfering channels at base station site. <u>By factory setting of interference sensing thresholds in base stations and subscriber terminals all possibility of fixed microwave interference from ISCDMA PCS is prevented throughout the U.S</u>. Regulation for the FCC becomes merely a matter of assuring proper interference sensing thresholds are set for subscriber terminals and base stations. This could be done through FCC type acceptance procedures.

  Contrast this to what might be involved if the FCC is required to regulate PCS operators using so called "exclusion zones" as the basis for frequency sharing of PCS with fixed microwave. In an exclusion zone approach interference sensing is not used. Instead each cell must be carefully mapped <u>in its entirety</u> for possible interference to fixed microwave in any part of the cell. Channels which might produce detectable interference to fixed microwave interference in any part of the cell are excluded from use by base station and subscriber terminal. The remaining channels alone are used. Under these circumstances, protection of the microwave user becomes a matter of the accuracy of the initial interference mapping and the careful adherence of the PCS operator to the restrictions indicated by the mapping.[19] Regulation under these circumstances could require examination of interference maps and mapping techniques of PCS operators, and policing of adherence to mapped exclusion requirements. This would be an impossible regulatory task.

- Certainty of protection for fixed microwave users. Under ISCDMA, the fixed microwave user knows that each PCS base station and subscriber terminal is configured with interference sensing at thresholds giving absolute protection against detectable interference to fixed microwave. This certainty should allow present fixed microwave users to drop opposition to PCS sharing with fixed microwave. CTP believes that the alternative frequency sharing approaches of broad band CDMA or use of exclusion zones would be seen as affording less certain protection by fixed microwave users. Adoption of either of these approaches could result in continuing opposition to frequency sharing from fixed microwave users.

B. <u>High Interference Geographies</u>.

In certain metropolitan areas enough fixed microwave transmission exists in the 1850 - 1990 MHz band that even narrow channel CDMA, with its high

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[19]Note too, one defect of the exclusion zone approach is that once mapping is done no further microwave users can be admitted to the area without remapping and recreating exclusion zones. ISCDMA, on the other hand, allows entrance of new microwave users as the system would dynamically adjust for the new interference of the new users. This is why since September 1990 CTP has been stating its approach would, with certain restrictions, allow secondary rather than co-primary status with fixed microwave.

capacity, must deal with capacity limitations in shared use.[20] The way that the capacity need is dealt with in a particular situation depends ultimately upon subscriber demand in a given area. Initially, cells will be fairly large as demand is low at PCS introduction stage. It is in this stage that the capacity gain from ISCDMA is of greatest use. Cells that are several miles across (and cells this size could be easily served by CDMA) might have several microwave paths at differing frequencies crossing different parts of the cell. Rather than exclude all channels which might interfere with the fixed microwave transmissions at any part of the cell, ISCDMA allows channels unusable in certain parts of the cell to be used in other parts of the cell, for an overall capacity gain in the cell. This reduces capital cost (the need to introduce additional cells/base stations to serve subscribers). This in turn results in lower cost to subscribers.

When subscriber demand grows further in a given area, channel splitting (smaller cells) is in order. One advantage of CDMA is that with a small cell, base station power (and summed power on a given transmission channel) will be reduced, allowing channels previously interference blocked in the larger, higher power cell to become useable. ISCDMA would automatically adjust for this through the scanning process. Also, of course, there is an automatic, and with CDMA substantial, capacity gain in the area resulting from frequency repeat with smaller CDMA cells.

In areas which are severely impacted by fixed microwave, smaller cells might have to be introduced at the outset to provide needed capacity on the limited number of frequencies in the area free from fixed microwave interference. In other words, cell size will be determined by a combination of subscriber demand and the extent of fixed microwave interference in an area.

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[20] This is particularly true if, as CTP advocates, multiple PCS operators are licensed by the FCC in each geography. In this connection, one of the advantages of narrow channel CDMA is that it allows multiple PCS operators either to co-exist through having separate frequency allocations in the 1850 - 1990 MHz band or to co-exist based on relative demand. Co-existence based on demand would mean that all operators could dynamically share the same frequency (1850 - 1990 MHz), an approach eminently workable with ISCDMA. Indeed this may be a fairer approach in a fixed microwave environment as "hard" frequency allocation might result in unfair treatment of some operators in some geographies where their particular block of frequency happens to be more impacted by fixed microwave than the frequency blocks of other operators.

Finally, there might be a very few areas so severely impacted by fixed microwave in the 1850 - 1990 MHz band that no free channels exist for ISCDMA. Certainly this could be true for a TDMA approach, particularly a TDMA approach using exclusion zones. However, this same cell using CDMA and using the spectrum spreading capability of CDMA to reduce interference to fixed microwave, and operating at low power both because of use of CDMA and small cell size, should have channels available for ISCDMA.

Thus CTP questions that in any given geography in the country (a microwave "hot spot") it will be found that microwave users are so closely packed in geography and frequency that it will be impossible to find non-interfering room for at least a few low power, 1.228 MHz CDMA channels. The experience of Cellular Data, Inc., a company of which Lockton of CTP was Chairman, bears this out. Lockton, while at Cellular Data helped develop a technology which inserts narrow channel data transmission at 2400 bps into cellular radio frequencies without interfering with cellular voice transmissions. The technology works successfully in the most densely packed and sectorized cellular systems in the U.S., and is now well known to the FCC and the cellular industry. At the time the technology was developed (Fall 1987) there was substantial industry doubt narrow channel transmission could be inserted into cellular without interference, but testing proved the viability of the approach. So, too, testing will be needed of ISCDMA in microwave transmission hot spots to convince doubters.[21]

It should be noted that while ISCDMA will add capacity in areas with substantial fixed microwave transmission by increasing the number of useable channels, the previously discussed advantages of regulatory certainty and certainty of protection of fixed microwave users remain perhaps even more important. <u>The more microwave in an area, and the more complicated the layout of microwave frequency use and microwave paths in an area, the more an approach which automatically adjusts to avoid microwave interference makes sense</u>. This is why ISCDMA was developed.

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[21]If testing proves that in microwave transmission hot spots even ISCDMA does not find useable channels, CTP would not recommend near term relocation of the microwave users. The number of such hot spots will be so few using ISCDMA that it is far better to have PCS operators work around them than to have to deal with fixed microwave user opposition to PCS and consequent possible delay of introduction of PCS.

Conclusion. In its pioneer's preference request QUALCOMM refers to the interference testing it is starting to perform and states: "The information gathered in the field trials being conducted by QUALCOMM will provide the basis for implementing software changes to the basic CDMA system so that 'co-existence' criteria can be used in PCS operations." CTP feels that these software changes will be few and can be quickly accomplished. Subscriber terminal receiver sensitivity to pilot channel degradation must be tested to ensure that subscriber terminals will not operate on transmission channels which might cause microwave interference. Pilot channel interference sensing in a high demand cell must be demonstrated. Finally, the capability of ISCDMA in microwave interference "hot spots" must be established. It is CTP's belief that all of this can be accomplished to Commission satisfaction in relatively short order, allowing rapid deployment of ISCDMA throughout the U.S.[22]

[22]In this regard CTP notes that many applicants are proposing narrow channel CDMA in various parts of the country, particularly QUALCOMM's technology. CTP very much welcomes this. CTP believes these applicants can and will work together to create national roaming for narrow channel CDMA, and eventually an integrated system across most of the U.S. In this connection, CTP particularly supports the activities of Telemarc Telecommunications, Inc. which is working to create a national network of PCS operators using QUALCOMM technology.

Types of Handoff

- **Idle handoff**
  - When receiving the Paging Channel
- **Soft handoff**
  - Operate with multiple base stations
  - Make before break operation
- **Hard handoff**
  - Between CDMA frequency assignments
  - On the same CDMA frequency assignment (intersystem handoff)
- **CDMA to analog handoff**

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Idle Handoff Steps

- Mobile station searcher reports that new base station pilot level has exceeded old base station level by a certain amount for some time
- Mobile station assigns fingers to the new base station
- Mobile station uses NGHBR_CONFIG field to determine what to do
    - Just slide to using same Paging Channel and CDMA frequency
    - Go to Primary CDMA frequency assignment and use Primary Paging Channel
    - Use Primary Paging Channel on first CDMA frequency assignment in CDMA Channel List Message
    - Acquire Sync Channel on the Primary CDMA frequency assignment
- If previously received base station, checks overhead sequence numbers
    - If not changed, slotted mobile station goes to sleep
    - If changed, stays awake to receive overhead messages
- Minimizes
    - The amount of time not receiving the Paging Channel
    - Power consumption

QUALCOMM® INCORPORATED

Soft Handoff Steps
(Normal Operation)

- Mobile station searcher reports that new base station pilot has exceeded T_ADD
- Mobile station reports this in a *Pilot Strength Measurement Message*
- Base station sends *Handoff Direction Message* putting mobile station in soft handoff
- Mobile station assigns fingers to receive both old and new base stations
- Mobile station searcher reports that old base station pilot has dropped below T_DROP
- Mobile station reports this in a *Pilot Strength Measurement Message*
- Base station sends *Handoff Direction Message* taking mobile station out of soft handoff

TAB

PCS/PASSIVE FIBER OPTICS INTERFACE

In the past year there has been substantial progress on development of combined fiber in the local loop ("FITL") and SONET provisioning for business. Attached is a description of the basic technology to provide 10,000 lines for combined residential and business use (Figure A in the attachment). Residential users are to be provided bandwidth on demand through passive fiber optics (Figure D). Business customers are to be offered HiCap and other data services (along with voice) from a Sonet network (Figure E).

Passive fiber optics is described in a further attachment. The advantages of passive fiber optics in the local loop include:

- Passive splitters eliminating need for powering at splitter sites.
- Elimination of need for large housings in distribution plant. This is particularly important in urban and other geographies where room for housings is limited.
- Limited maintenance of distribution plant. Electronics are located at the CO.
- Lower cost as a result of lower maintenance need, central location of electronics and elimination of housings. Passive fiber has become less expensive than twisted pair for subscribers located more than 5 - 7,000 feet from CO, and the distance cross over point for economic service by passive fiber is steadily decreasing.

CTP has been working on interfacing PCS with passive fiber optics in the local loop for approximately one year. The work has principally been with Fulcrum Communications, Inc., a company owned three quarters by Fujitsu and one quarter by British Telecom.

To CTP's knowledge Fulcrum has the only passive fiber approach for the local loop which allows delivery of bandwidth on demand. This means from ONU one subscriber can be allocated fiber base POTs service, and the next video on demand; and the reconfiguration to accomplish this can be done centrally without adjusting electronics or fiber feeds in the distribution plant.

The advantage gained from this is that the cost of fiber to distribution point can be shared by multiple services - POTS, data and video on demand. To this CTP has added PCS for further sharing of infrastructure cost and further savings in all applications (including PCS).

CTP believes that it along with Fulcrum are the only companies in the world actively developing a PCS interface with passive fiber optics.

In a PCS CDMA system, the CDMA base station is co-located with the Class 5 office. This approach is made possible by the greater capacity and greater range of a CDMA based system.

If the Class 5 office is digital, the connection between the base station and the switch is over ISDN Primary Rate trunk facilities. If the office is equipped with an analog switch, D/A and signaling protocol conversion equipment has to be included in the base station.

In a CDMA system, the capacity of the system (i.e., the number of active lines) can be increased, almost linearly, by antenna sectorization. Present Qualcomm equipment configuration limits the number of such sectors to six.

Field trials have shown that the capacity of a CDMA system in a cellular environment is between 20 - 40 active lines per sector per 1.25 MHz bandwidth channel. In a static system such as a wireless loop system, the effects of fading are either absent or greatly reduced. Because of the better propagation conditions, the capacity of a static system will be substantially greater than that of a cellular system.

Using conservative capacity numbers, and assuming an average busy hour usage per subscriber of 0.1 Erlang, up to 400 subscribers/sector per 1.25 MHz bandwidth channel can be served in the busy hour.

Assuming six sectors and the availability of ten 1.25 MHz channels, the total capacity of a CDMA base station would be up to 24,000 subscribers.

Further capacity increases can be achieved by increasing the number of sectors or by an increase in the total bandwidth available. Another option is to increase the number of base stations, each serving a particular part of the central office geography.

The advantage of the centralized approach is that no infrastructure needs to be provided between the central office and the subscriber locations. This minimizes the total investment required, eliminates the need for right of way or real estate, and reduces potential maintenance costs.

To support PCS wireless local loop services, the fibers to the distribution points must carry 70 MHz signals initially, as indicated in the attachments hereto; this would initially be separate fiber, but development is underway for integrating PCS, POTS, data and broadband together in broadband passive fiber to distribution points.

For PCS there would be located at network distribution points up-and-down converters as well as radio transmitters and receivers that radiate to or receive from subscriber terminals. These subscriber terminals can be fixed or portable. Fixed units are mounted either inside or on the outside walls of the subscribers' houses or apartments. In large apartment buildings, distributed antennas (which are, in effect, distributed micro cells) are used to distribute the signals within the building. These distributed antennas are designed to take advantage of CDMA's unique capability to combine multipath signals that arrive with differences in time delays of greater than 0.8m sec.

HOMEWORX/SONEPLEX INTEGRATED ARCHITECTURE

The major components that are integrated into the ADC system include the SONET Interface Unit (SIU), the HiCap Distribution Unit (HDU), the Homeworx FITL HDT and the Broadband Distribution Unit (BDU). Figure A shows this Integrated Architecture.

Soneplex/Homeworx—Integrated Architecture

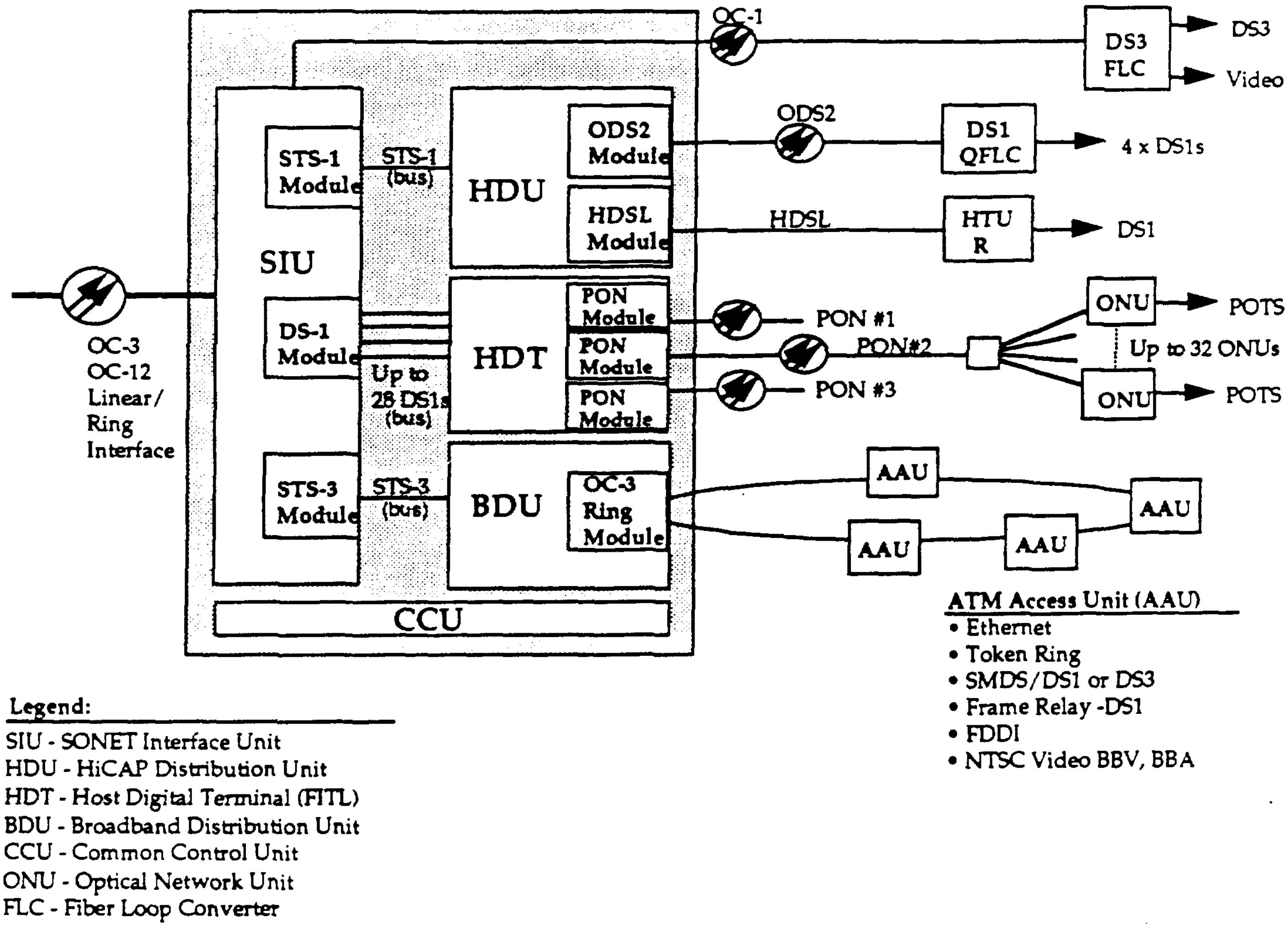


Figure A

The SONET Interfaces Unit (SIU) is the network interface at either an OC-3 or OC-12 rate. This unit can be configured in a terminal multiplexer (TM) or Add/Drop Multiplexer (ADM) application. The SIU incorporates a time slot interchanger of 84 x VT1.5 or 4 x STS-1 using the DS1/VT1.5 async/byte-sync mapping structure. Appropriate DS1, STS-1, STS-3 or STS-3C are integrated interfaces to the HiCap Distribution Unit (HDU), the Homeworx FITL HDT and the Broadband Distribution Unit (BDU). Figure B shows the system's platform inter-unit interfaces.

Soneplex Platform—Inter-Unit Interfaces

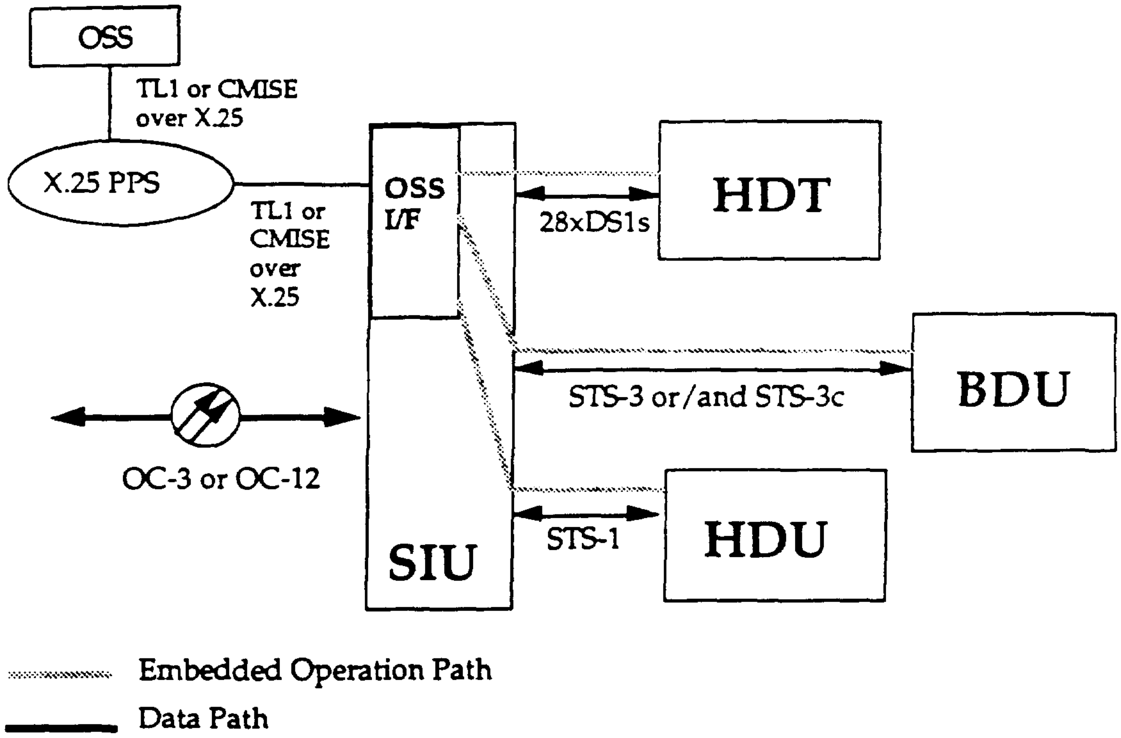


Figure B

The system capacity is determined by the mix of system components. Service of POTS, HiCaps or data can be driven exclusively from the SIU as shown in Figure C or can be mixed for various options based on the customer's mix of service needs.

Soneplex System Capacity (Sample Scenario)

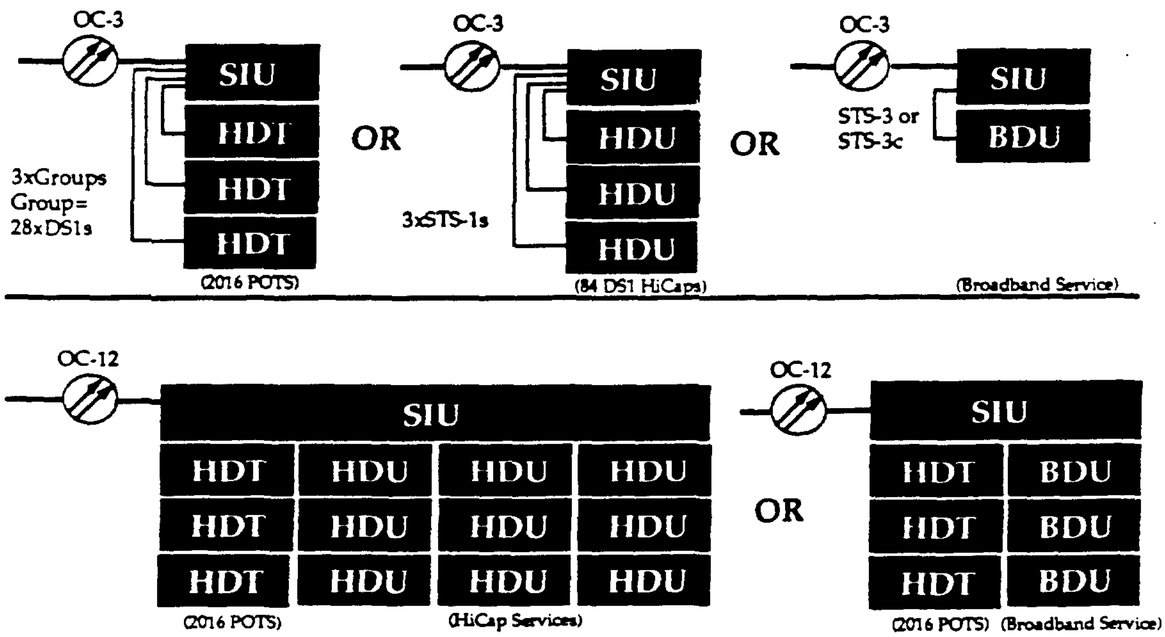


Figure C

HOMEWORX/FITL HDT INTEGRATION

The ADC Homeworx is a passive optical network (PON) Fiber In The Loop (FITL) system developed jointly with Fulcrum Communications. Homeworx is a PON system with many unique characteristics. One of the most significant is the ability to deliver the full 20 Mb/s of bandwidth to any of the 32 Optical Network Units (ONU). This allows for bandwidth allocation for higher-speed digital services when necessary. Although being capable of economically being utilized for POTS service, the ADC Homeworx system can also deliver wireless and video services efficiently.

The integration of the HDT into the Soneplex system allows a highly flexible platform for local-loop applications. The Common Control Unit (CCU) is used for terminating the SONET Data Communications Channel (DCC). The CCU allows the system to be utilized in applications that traditionally combine fiber multiplexers with digital loop carrier equipment, offering additional bandwidth flexibility. Figure D shows a simple applications diagram for the Soneplex/HDT.

Soneplex HDT Application

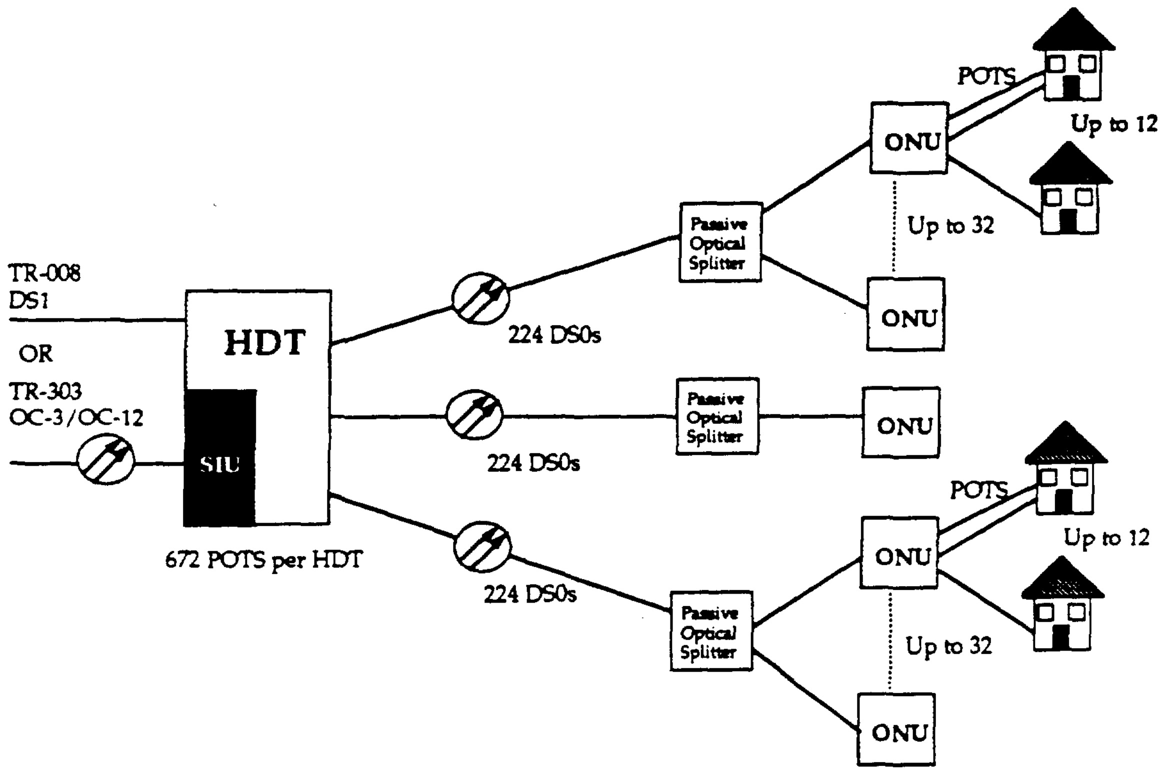
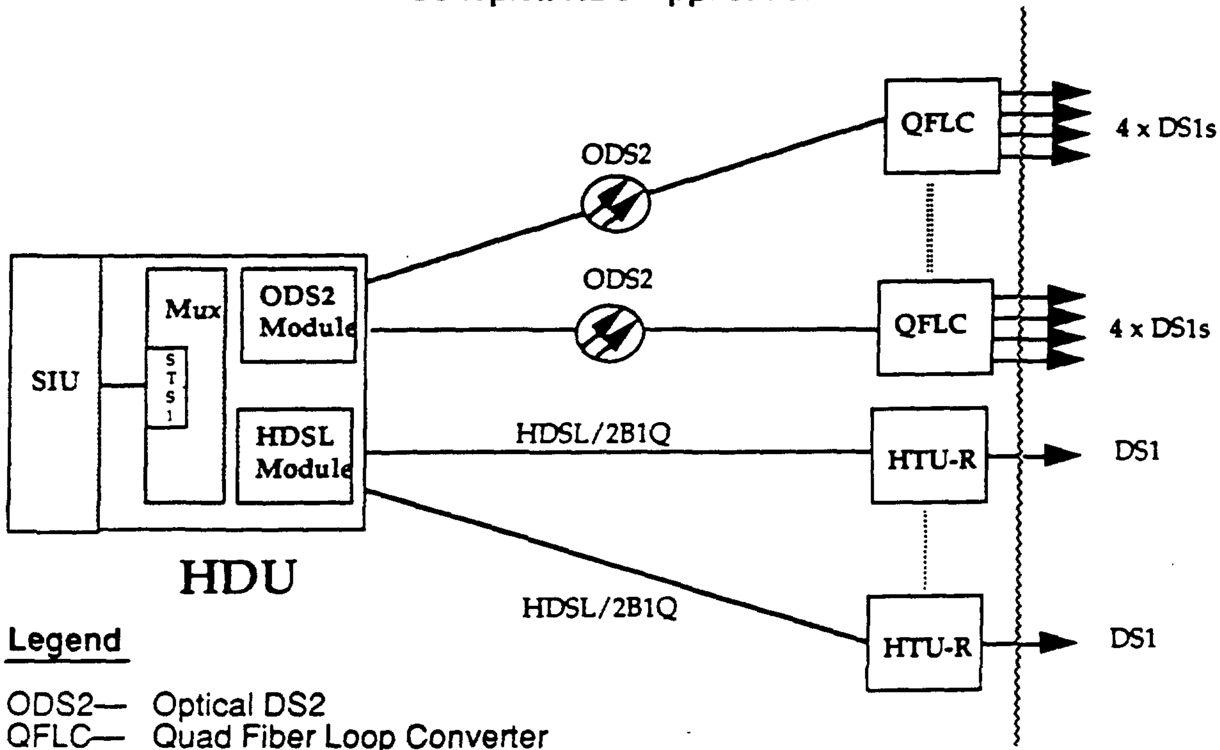


Figure D

HiCap Distribution Unit (HDU)

The integrated HiCap Distribution Unit accepts an STS-1 derived from an OC-3 or OC-12 from the SONET network via the SIU and is designed specifically for the delivery of HiCap services. These HiCaps, up to 84 DS1s, can be transported to customers over fiber or copper. Up to 28 DS1s derived from one STS1 can be configured for delivery from the HDU as 7 optical DS2s, 28 HDSL circuits or a mix of each. When transporting over fiber an optical DS2 transports 4 DS1s to a customer. Copper DS1 transmission utilizes HDSL/2B1Q technology. Therefore, you have a flexible platform for delivery of HiCaps on either fiber or copper. These alternatives allow maximum use of your network facilities. Figure E shows a simple application drawing of the HiCap Distribution Unit (HDU).

Soneplex HDU Application



Legend

ODS2— Optical DS2
QFLC— Quad Fiber Loop Converter
HTU-R— HDSL Remote Module

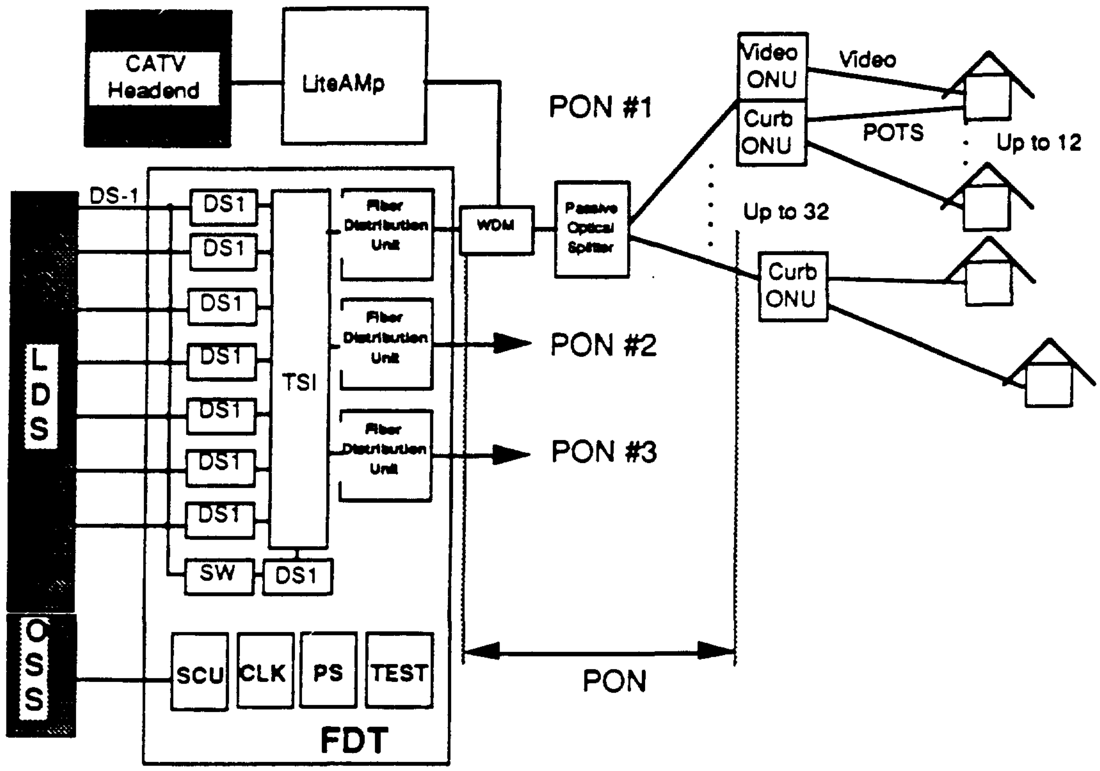
Figure E

The Homeworx/Soneplex system also has the ability to integrate data transport capabilities via the Broadband Distribution Unit (BDU). The application for this portion of the system is for SMDS, frame relay, and Native Rate LAN-to-LAN interconnections. Some key features to the Broadband Distribution Unit (BDU) is the ATM matrix whose primary function is to map data into 53 byte cells and converge these cells onto an STS-3C payload. This insures efficient transport through the SONET network. This application is ideal for supporting various customer interfaces such as LAN IEEE 802.3 or 802.5 and compressed NTSC video that can be transported through a uni-directional fiber ring based on specifications in TA-TSY-000496 Issue 3.

Near Term Video Transport Solutions:

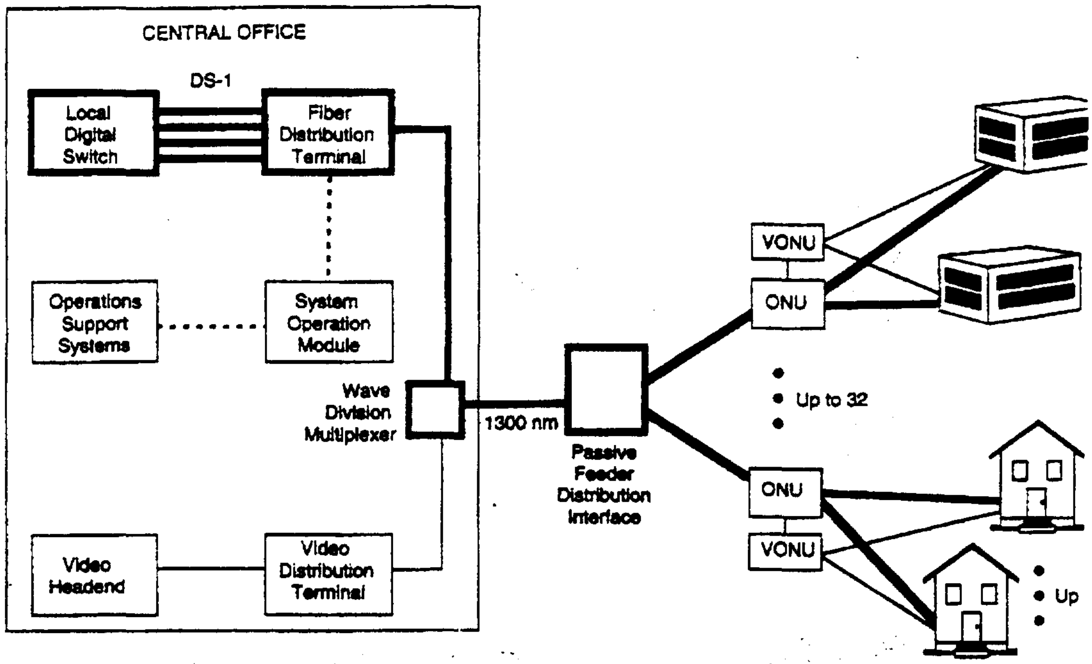
The ADC FITL System utilizes equipment manufactured by American Lightwave Systems (ALS) of Wallingford Connecticut. ALS is a subsidiary of ADC Telecommunications. The ALS LiteAmp system allows the simultaneous delivery of 60 to 80 NTSC video channels over the same passive optical network as the telephony services. The 1310 nm optical window is reserved for telephony, the 1550 nm window is used for broadcast video. Signals are combined at the exchange end and separated at the ONU by WDM techniques. From the ONU, video signals are converted to electrical format by a video ONU (VONU), and delivered to subscribers via coaxial cable. As an alternative, 1310 nm transmission may be utilized on a second fiber.

Refer to the accompanying figure. Video service is derived from the video source, which may be located outside the central office. If desired the WDM used to combine video and telephone signals could be placed at the splitting location in the outside plant, allowing the use of separate fiber plant for video carriers for feeder networks.



FITL System Description

Narrowband or POTS Service



For delivery of narrowband services, the ADC FITL System consists of a single Fiber Distribution Terminal (FDT), the Optical Network Units (ONUs), and a passive splitter or Feeder Distribution Interface (FDI). For those installations requiring video services, the Video Distribution Terminal (VDT) and the Video Optical Network Units (VONUs) can be deployed either at the time of initial installation, or as in-service upgrades without the need to add additional fiber. All of the system elements are designed in accordance with telecommunications industry standards (such as TR-TSY-000063 and TA-NWT-000909) to provide the high levels of quality and reliability telcos have come to expect from ADC.

The ADC FITL System utilizes a proprietary time division multiple access (TDMA) technique to deliver up to 192 DS-0 channels per PON to customers over two singlemode fibers (one for each direction of transmission). TDMA transport allows great flexibility in assigning bandwidth to customer terminations.

The FDT is the interface between the network and the FITL System, providing service to up to 768 customers over four distinct PONs. For each PON, the PON Transport Modules within the FDT convert eight DS-1s from the local digital switch to an optical bit stream. The PON Transport Modules include two DS-1 Interface Modules, and the PON Transport Master and Optics Modules. Each DS-1 Interface Module terminates four DS-1s, and is compatible with TR-TSY-000008 (or in future enhancements, TR-TSY-000303). In addition to the PON Transport Modules, the FDT contains common equipment for controlling and administering system functions. The FDT provides its own security system to prevent unauthorized access to network resources, and an interface to office alarm and E2A alarm telemetry systems.

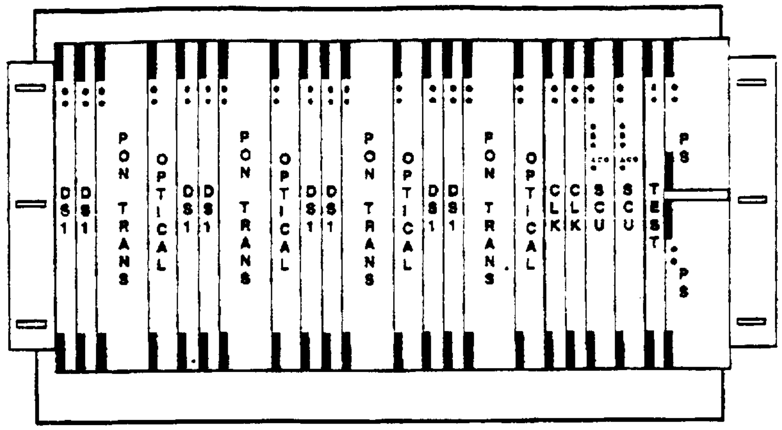
The transport fibers pass through the passive splitters for distribution to the ONUs. The passive splitters can be located in a simple outside plant pedestal, or in a CO/CEV/Hut near the FDT or Fiber Distribution Frame (FDF). The number of fibers, and the number and type of splitters can vary from one system configuration to the next; the PON Transport System is engineered to accommodate a maximum splitting ratio of 1:32 for narrowband applications. This high splitting ratio, and the flexibility offered in system configuration by the TDMA transport, allows the ADC FITL System to be cost effective in virtually any geographic arrangement and number of customers.

Because of the large number of fibers entering the passive distribution point, it has been designed to manage these fibers in and out of the pedestal using the expertise gained in the development and deployment of ADC's Fiber Distribution Frames and Fiber Panels.

Once the signal has arrived at the ONU, the PON Transport Slave and Optics Modules decode the downstream signals and encode the upstream signals. These modules make the optical/electrical and electrical/optical conversions. The PON Transport Slave and Optics Modules communicate with the appropriate PON Transport Master Module in the FDT. The customer channel units, located in the ONU, convert the digital signals from the PON Transport Slave Module to appropriate customer interfaces. The system will accommodate POTS, Basic Rate ISDN, Coin, and various Special Service Channel Units.

Fiber in the Loop
Network Elements

The Fiber Distribution Terminal, or FDT, provides the interface to the network for switched services and special services, the interface to a SOM and craft interface devices and the monitor and alarming functions for the system. The FDT mounts in a 23" relay rack. PON System Transport Modules that plug into the FDT include:

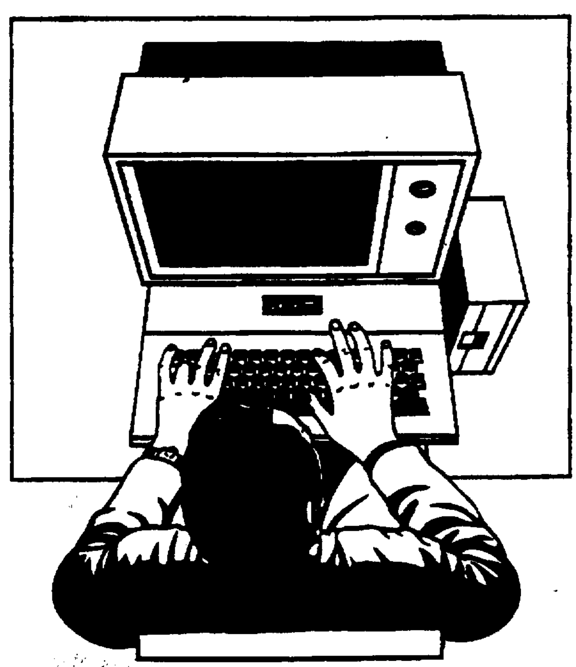


- DS-1 Interface Modules
- PON Transport Master Modules
- PON Transport Optical Modules, which provide the electrical/optical signal conversions

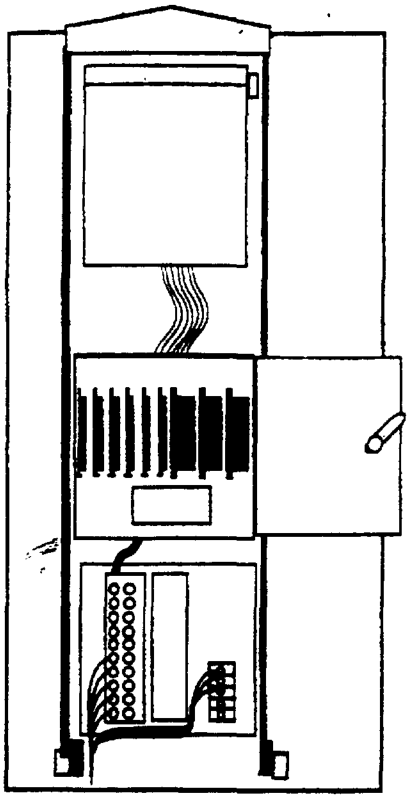
The common equipment modules that plug into the FTD are:

- Shelf Controller (SCU) Units, which provide the interface for provisioning, testing, gathering and reporting the system performance and alarming data. The SCU Modules can communicate with multiple PON Transport Modules.
- Clock Unit, which provides time base generation for DS-1 synchronization.
- Power Supply Units, which operates from a -48VDC central office battery and derives the operating voltages for the various FDT modules. One power supply is all that is required to operate the system; a second power supply provides redundancy.
- Test Unit, which provides control and reporting functions for channel testing and drop testing.

The **System Operations Module (SOM) & Operations Interfaces** serves as the primary user interface to the FITL System. It consists of ADC proprietary software running on a UNIX-based computer. A single SOM provides integrated database management, security, performance monitoring and provisioning features for up to 100 FDTs using industry standard TL1 messages.



The SOM allows users to control and configure their FITL Systems from a remote location, such as a maintenance center or network control center, via either dedicated lines or an X.25 packet switched network. The SOM also provides a bridge between the FITL System and existing Operations Supports Systems (OSS) such as FACS ,

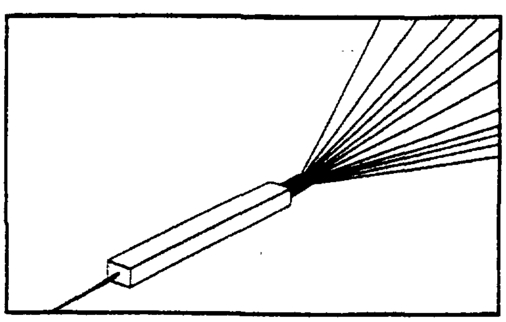


The **Optical Network Units (ONUs)** are active pedestals appropriate for several applications. The ONU contains mounting hardware for modules and power supplies, and termination and distribution hardware for copper cable and optical fibers. The FTTC ONUs will be available in above ground and below grade enclosures. For areas where aerial cable is deployed, the pole mount enclosures can be used.

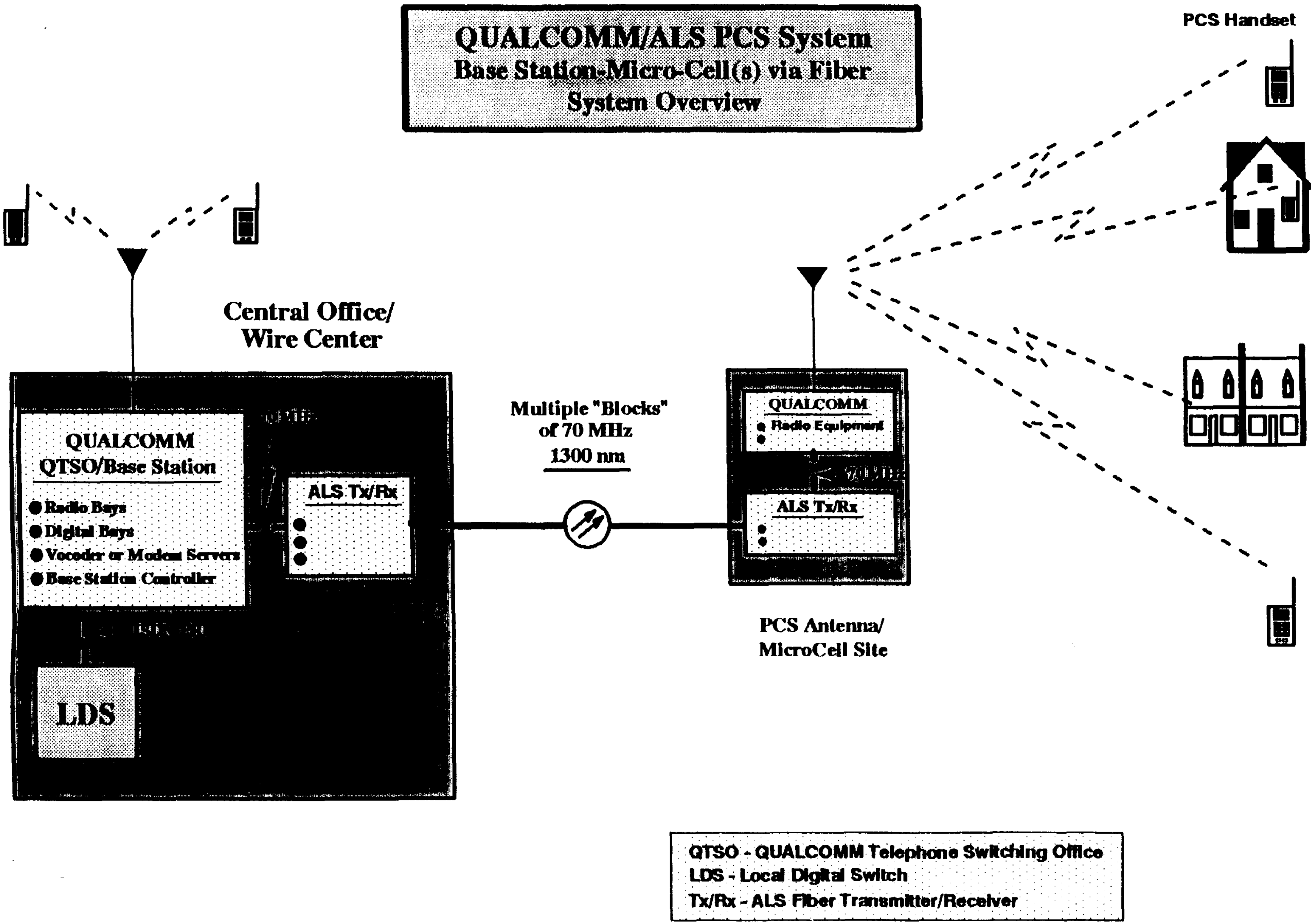
The Fiber to the Curb (FTTC) ONU was designed for residential and small business applications. ADC 's FTTC ONUs are capable of delivering 1-12 customer access lines. This unit typically would serve four to six single family living units or small business locations. A FTTC ONU will also be available to serve multi-tenant living units. ADC also plans an FTTH ONU capable of serving a single family living unit.

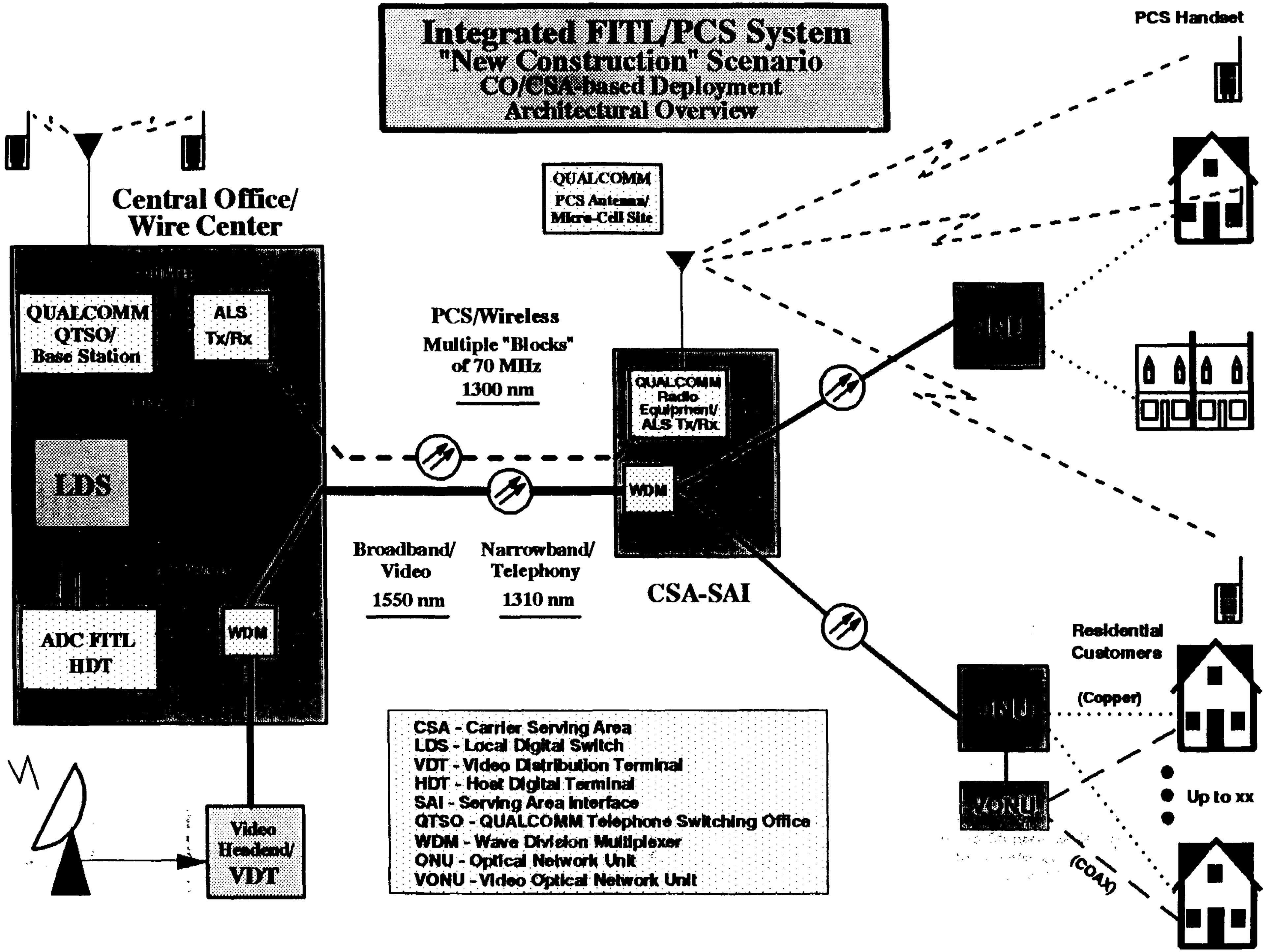
The modules in the ONU include:

- PON Transport Slave and Optics Modules, which interface to the distribution fibers.
- Remote Test Unit (RTU), which provides the test interface in the ONU. The RTU allows telco personnel to perform metallic loop tests from a remote location. It also communicates performance monitoring data on the status of the PON and of the ONU back upstream to the PON Transport Master and the SCU Modules.
- Power Supply Unit (PSU), which interfaces with the powering scheme, either Network or Local Fed Power. This unit converts the -48VDC or -130VDC power feed to the operating voltages required for the ONU.
- Customer Channel Units, which provide the electrical interface to the customer premises. The choice of channel unit is determined by the service the customer requires.



The **Passive Splitter** is an optical component that divides optical power equally among a number of distribution fibers. The splitter is physically located in a simple outside plant enclosure which houses, in addition to the passive optical splitters, feeder and distribution fibers.


QUALCOMM/ALS PCS System
Base Station-Micro-Cell(s) via Fiber
System Overview
PCS Handset
Central Office/
Wire Center
QUALCOMM
QTSO/Base Station
Radio Bays
Digital Bays
Vocoder or Modem Servers
Base Station Controller
ALS Tx/Rx
LDS
Multiple "Blocks"
of 70 MHz
1300 nm
QUALCOMM
Radio Equipment
ALS Tx/Rx
PCS Antenna/
MicroCell Site
QTSO - QUALCOMM Telephone Switching Office
LDS - Local Digital Switch
Tx/Rx - ALS Fiber Transmitter/Receiver


Integrated FITL/PCS System
"New Construction" Scenario
CO/CSA-based Deployment
Architectural Overview
PCS Handset
QUALCOMM
PCS Antenna/
Micro-Cell Site
Central Office/
Wire Center
QUALCOMM
QTSO/
Base Station
ALS
Tx/Rx
LDS
ADC FITL
HDT
WDM
PCS/Wireless
Multiple "Blocks"
of 70 MHz
1300 nm
Broadband/
Video
1550 nm
Narrowband/
Telephony
1310 nm
QUALCOMM
Radio
Equipment/
ALS Tx/Rx
WDM
CSA-SAI
ONU
VONU
Residential
Customers
(Copper)
(COAX)
Up to xx
Video
Headend/
VDT
CSA - Carrier Serving Area
LDS - Local Digital Switch
VDT - Video Distribution Terminal
HDT - Host Digital Terminal
SAI - Serving Area Interface
QTSO - QUALCOMM Telephone Switching Office
WDM - Wave Division Multiplexer
ONU - Optical Network Unit
VONU - Video Optical Network Unit